



# **NASA Instrument Cost Model NICM**

## **Telescope Cost Estimating**

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# What is a Telescope?

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- The term TELESCOPE
- There are two camps of telescope people:
  - Camp 1 uses the term telescope to mean the actual “tube” itself, and considers the telescope to be independent of the detector subsystem sitting behind it, called the “backend”
    - Example: Hubble
  - Camp 2 uses the term telescope to mean the entire package:  
tube + backend = telescope
    - Example: HiRISE on MRO
- Summary:
  - Camp 1: Telescope = Tube
  - Camp 2: Telescope = Tube + backend

# What is an Instrument?

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- The term INSTRUMENT
  - How does the term *telescope* line up with the term *instrument*?
  - In NICM:

**Camp 1: Telescope = Tube  $\neq$  Instrument**

**Camp 2: Telescope = Tube + Backend = Instrument**

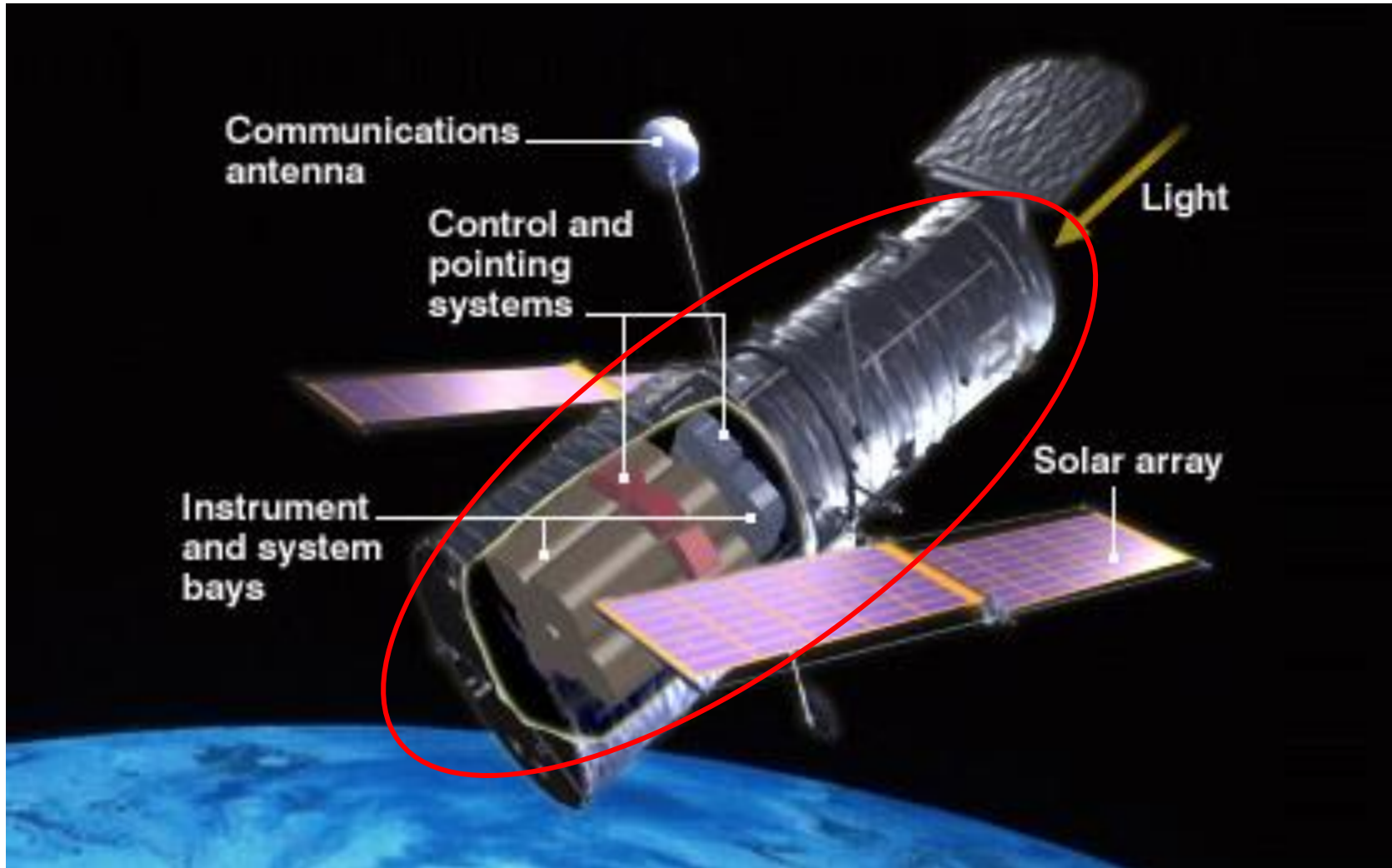
**This thus creates a 3<sup>rd</sup> camp as well:**

**Camp 3: Camp 2 – Tube = Backend = Instrument!**

# Review: Camp 1



# Review: Camp 2

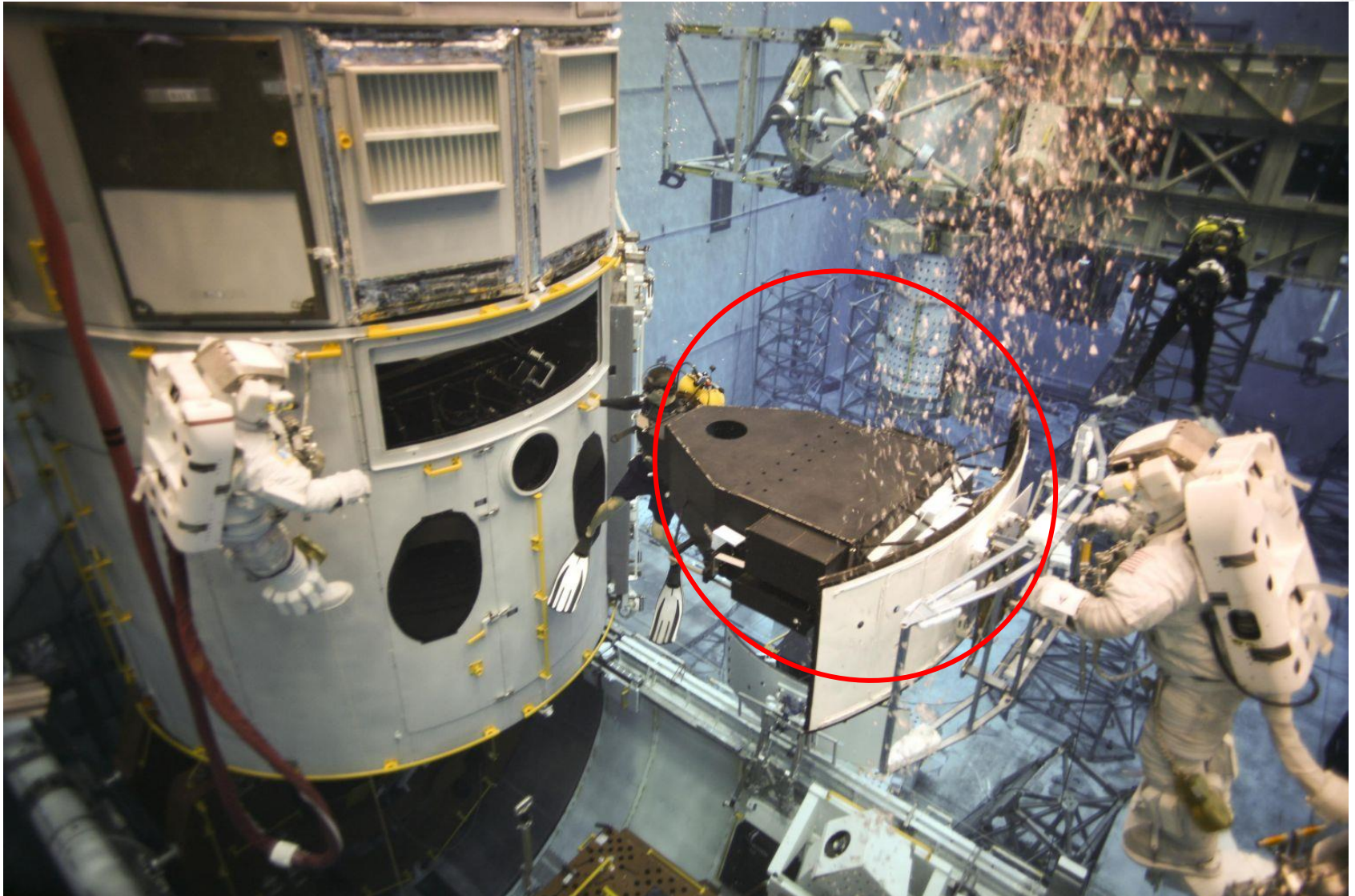


# Review: Camp 3





# Review: Camp 3





# Review: Camp 2

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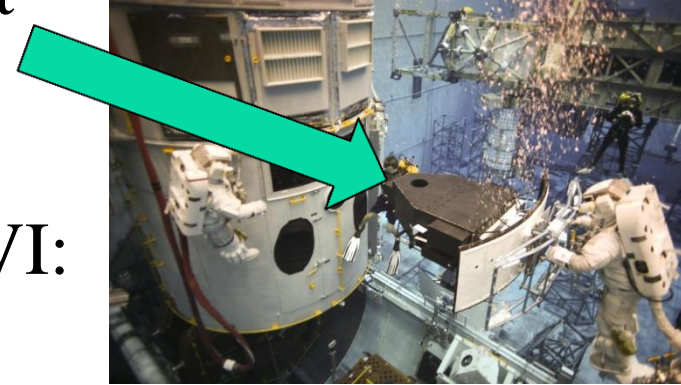
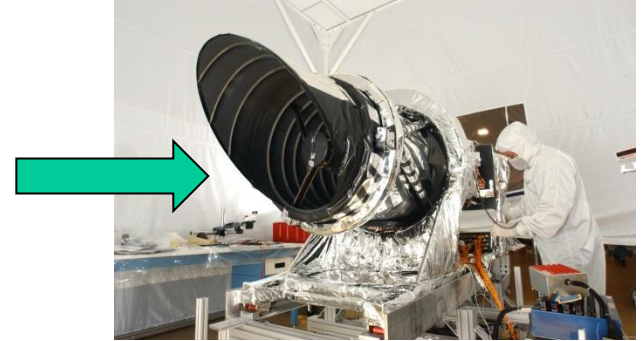




# Cost Estimating for Camps 1-3



- Camp 2 instrument are represented/supported by NICM, but only for smaller apertures
- Camp 3 instruments are represented/supported by NICM, but only for much larger apertures.
- Camp 1 is not supported by NICM VI: but they will be in NICM VII!



# Camps Divided by Apertures

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- Where does this bifurcation point between small and large apertures occur?
  - Within NICM, telescope+backend (Camp 2) instruments are typically of apertures of  $< 0.25$  m
  - For missions requiring  $> 0.25$  m or greater apertures, the instruments in NICM typically represent the backend only (Camp 3).
- But what if a user wants the cost of just the telescope frontend (Camp 1)?

# Telescope Cost Model's by Camp and Aperture

		Aperture Bins		
		< 0.25 m	0.25 m to 1.5 m	> 1.5 m
Camp 1	Tube Only	MIT	NICM-T	MSFC
Camp 2	Tube + Backend	NICM	~NICM + NICM-T	~MSFC+NICM
Camp 3	Backend Only	~ NICM-MIT	NICM	NICM

- MSFC = Marshall Large Telescope cost model
- MIT = MIT small telescope cost model
- NICM-T = The new NICM Telescope CER for apertures 0.25 m to 1.5 m

# NICM-T: Telescope Data

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	Aperture (m)	Band	mass (kg)	Cost \$M FY04
FUSE*	39	Infrared	130.9	9
GALEX	50	Infrared	98.8	16
IRAS	50	Infrared	130	31
WIRE	30	Infrared	85.3	11
Spitzer	85	Ultraviolet	133.8	57
WISE	40	Ultraviolet	110.6	80
HiRISE**	50	Infrared	39.7	14
Kepler	140	Infrared	336.1	67

\* FUSE had 4 identical telescopes. Numbers here are for 1.

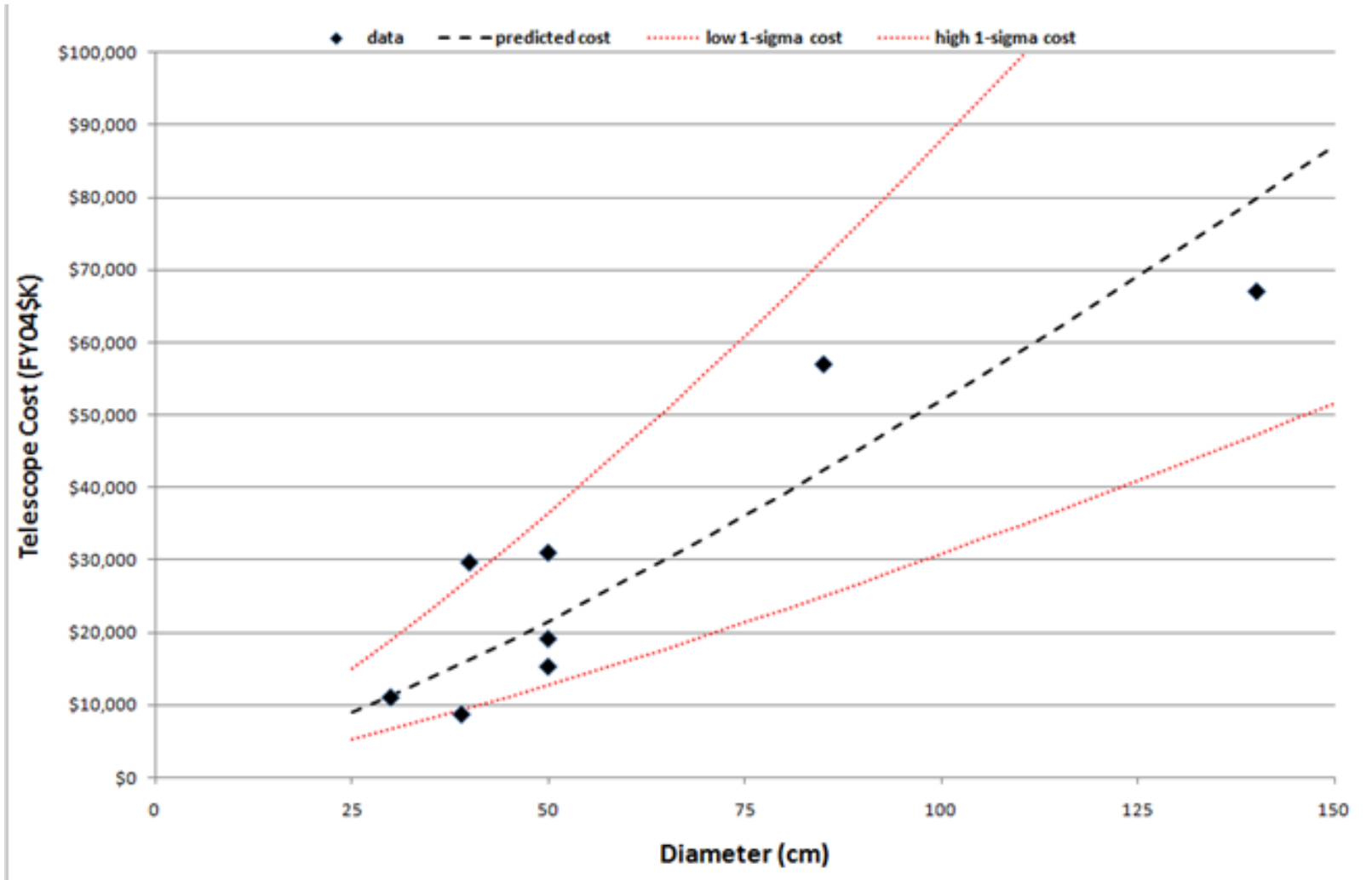
\*\*HiRISE was actually developed as a Camp 2 instrument. The NICM team was able to separate out the telescope mass and cost.



# NICM-T: CER Candidate 1



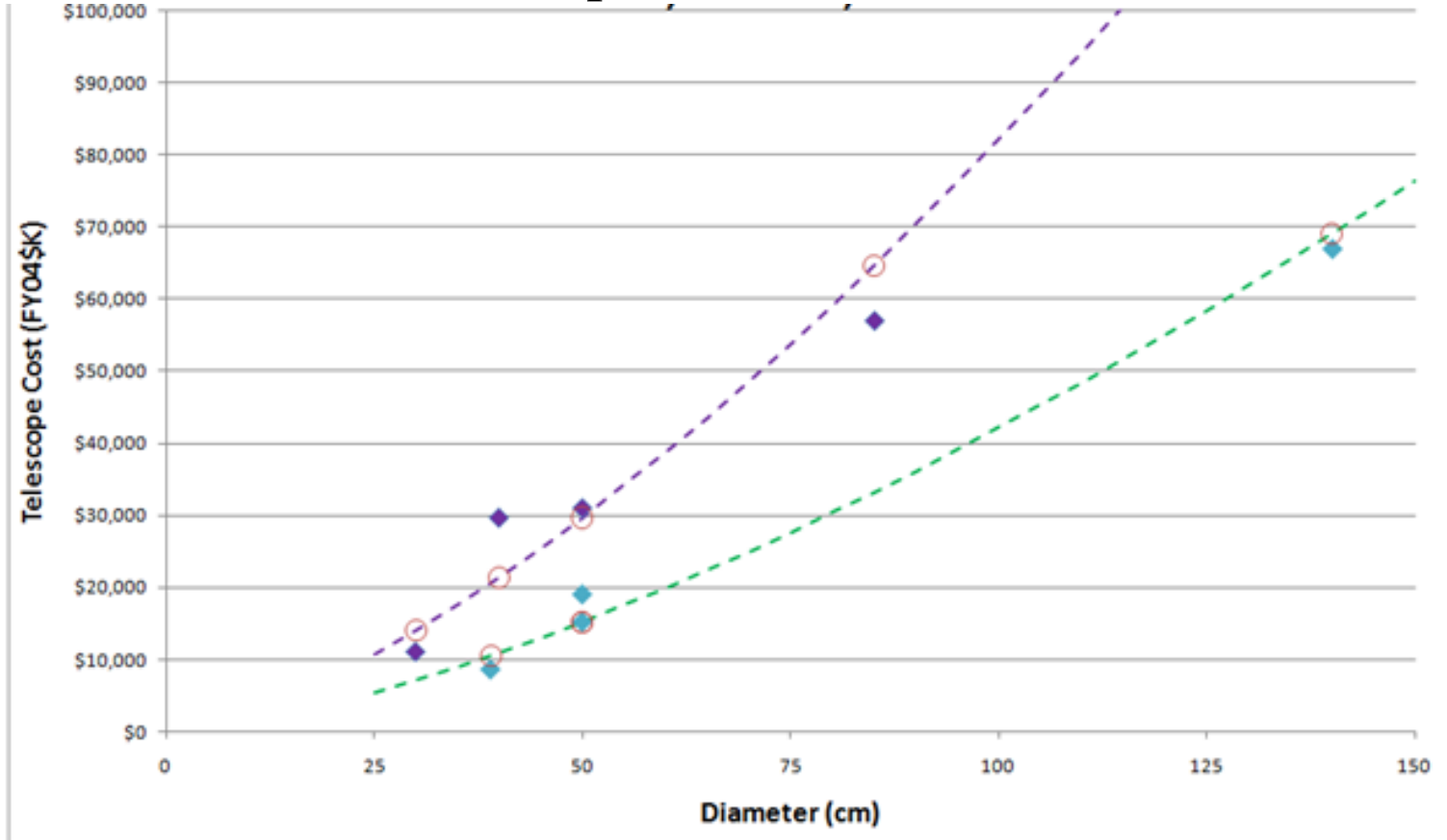
- Cost [FY04\$K] =  $149.38 * (\text{Diameter[cm]})^{1.271}$
- $R^2 = 71\%$ , SE = 43%, PE = 52%



# NICM-T: CER Candidate 2



- Cost [FY04\$K] = {49 Visible/UV, 95.4 Infrared} \* (Diameter[cm])<sup>1.467</sup>
- R<sup>2</sup> = 93%, SE = 23%, PE = 37%
- Green: Vis/UV. Purple: IR



# NICM-T CERs, Side-by-side Comparisons

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- Candidate 1:
  - Cost [FY04\$K] =  $149.38 * (\text{Diameter[cm]})^{1.271}$
  - $R^2 = 71\%$ , SE = 43%, PE = 52%
- Candidate 2:
  - Cost [FY04\$K] = {49 Visible/UV, 95.4 Infrared} \*  $(\text{Diameter[cm]})^{1.467}$
  - $R^2 = 93\%$ , SE = 23%, PE = 37%

# NICM-T Conclusions and Next Steps

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- Next Steps
  - Collect more telescope data
  - Recalibrate the 2 candidate CERs
  - Install best CER into NICM VII for release
- Conclusion:
  - NICM VII will include a new Telescope CER which will support estimating the cost of a telescope (tube only) for apertures 0.25 cm to 1.5 m, a capability not currently available.